Preprocessing

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns


%matplotlib inline
```

In [2]:
```
liver_df = pd.read_csv('liverLabTrain.csv')
```

In [3]:
```
liver_df.head(10)
```

Out[3]:
```
   Age  Gender  Total_Bilirubin  Direct_Bilirubin  Alkaline_Phosphotase  Alamine_Aminotransferase
0   65  Female              0.7               0.1                   187                        16
1   62    Male             10.9               5.5                   699                        64
2   62    Male              7.3               4.1                   490                        60
3   58    Male              1.0               0.4                   182                        14
4   72    Male              3.9               2.0                   195                        27
5   46    Male              1.8               0.7                   208                        19
6   26  Female              0.9               0.2                   154                        16
7   29  Female              0.9               0.3                   202                        14
8   51    Male              2.9               1.3                   482                        22
9   62    Male              6.8               3.0                   542                       116
```

In [4]:
```
from sklearn.preprocessing import OneHotEncoder
```

Binarizing the gender column

In [5]:

```
for i,x in enumerate(liver_df['Gender']):

        if x.lower() == 'female':

            liver_df['Gender'].iloc[i] = 0

        else:

            liver_df['Gender'].iloc[i] = 1
```

```
c:\program files\python37\lib\site-packages\pandas\core\indexing.py:670: Settin
gWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/sta
ble/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pyd
ata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-c
opy)
  self._setitem_with_indexer(indexer, value)
```

In [6]:

```
liver_df.head(5)
```

Out[6]:

	Age	Gender	Total_Bilirubin	Direct_Bilirubin	Alkaline_Phosphotase	Alamine_Aminotransferase
0	65	0	0.7	0.1	187	16
1	62	1	10.9	5.5	699	64
2	62	1	7.3	4.1	490	60
3	58	1	1.0	0.4	182	14
4	72	1	3.9	2.0	195	27

In [7]:
```
liver_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 483 entries, 0 to 482
Data columns (total 11 columns):
 #   Column                      Non-Null Count  Dtype  
---  ------                      --------------  -----  
 0   Age                         483 non-null    int64  
 1   Gender                      483 non-null    object 
 2   Total_Bilirubin             483 non-null    float64
 3   Direct_Bilirubin            483 non-null    float64
 4   Alkaline_Phosphotase        483 non-null    int64  
 5   Alamine_Aminotransferase    483 non-null    int64  
 6   Aspartate_Aminotransferase  483 non-null    int64  
 7   Total_Protiens              483 non-null    float64
 8   Albumin                     483 non-null    float64
 9   Albumin_and_Globulin_Ratio  480 non-null    float64
 10  Liver_Disease               483 non-null    int64  
dtypes: float64(5), int64(5), object(1)
memory usage: 41.6+ KB
```

In [8]:
```
liver_df.describe()
```

Out[8]:

	Age	Total_Bilirubin	Direct_Bilirubin	Alkaline_Phosphotase	Alamine_Aminotransferase
count	483.000000	483.000000	483.000000	483.000000	483.000000
mean	44.722567	3.299172	1.466253	287.335404	72.111801
std	16.263700	6.358002	2.783368	232.322630	148.754051
min	4.000000	0.400000	0.100000	75.000000	10.000000
25%	33.000000	0.800000	0.200000	174.500000	23.000000
50%	45.000000	1.000000	0.300000	206.000000	34.000000
75%	57.000000	2.600000	1.250000	298.000000	58.000000
max	90.000000	75.000000	19.700000	2110.000000	1680.000000

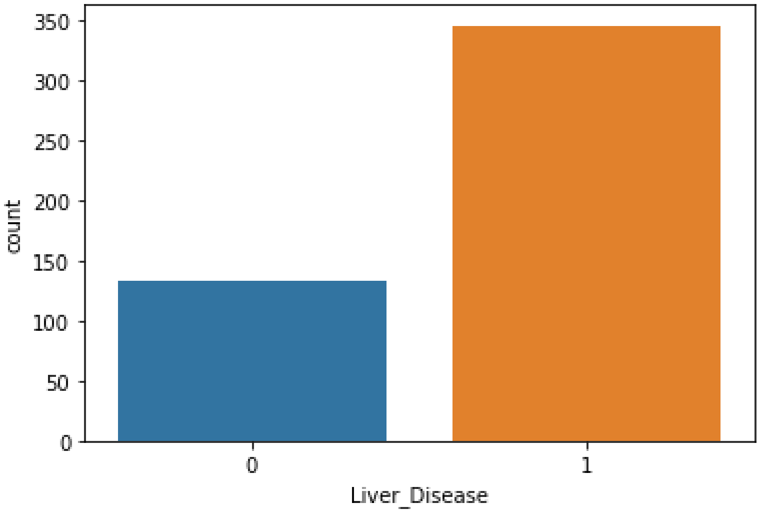
Missing data

In [9]:
```
liver_df.dropna(inplace=True) #Dropping 3 rows where Albumin_and_Globulin_Ratio i
```

Visualizations

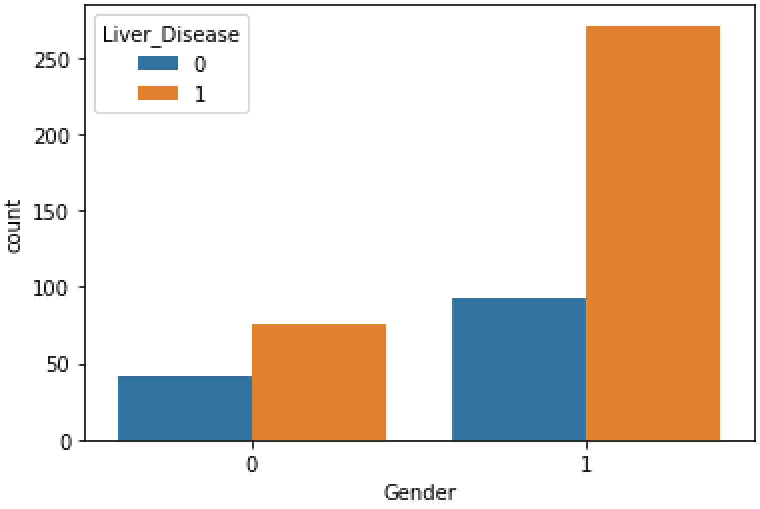
```
In [10]: sns.countplot(liver_df['Liver_Disease'])
```

```
Out[10]: <matplotlib.axes._subplots.AxesSubplot at 0x1c2757752c8>
```



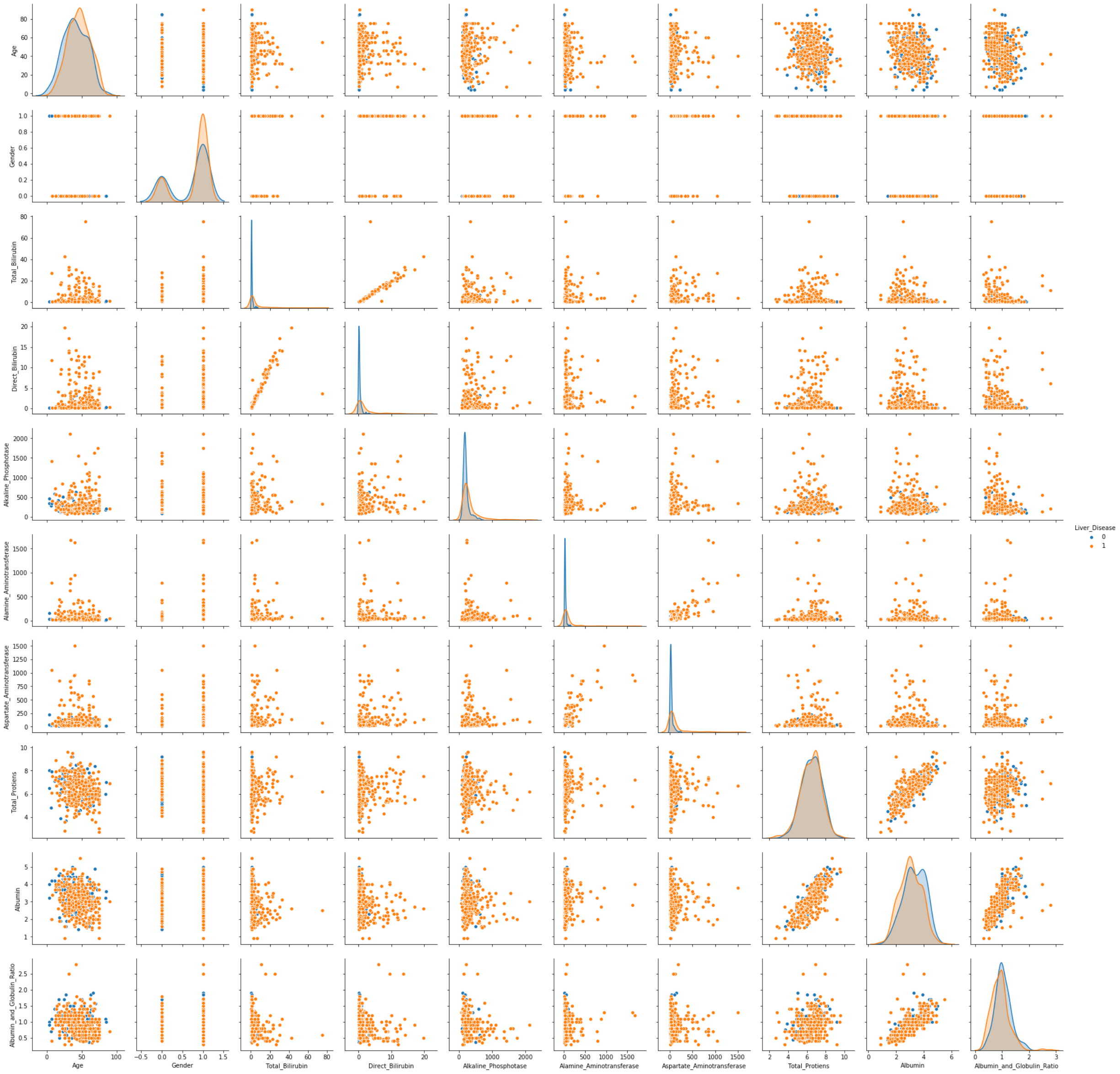
```
In [11]: sns.countplot(data = liver_df, x = 'Gender', hue='Liver_Disease')
```

```
Out[11]: <matplotlib.axes._subplots.AxesSubplot at 0x1c2787d6808>
```



In [12]:
```
sns.pairplot(data = liver_df, hue = 'Liver_Disease')
```

Out[12]:
```
<seaborn.axisgrid.PairGrid at 0x1c27888fe48>
```



Preparing data for model

In [13]:
```
X = liver_df.drop(['Liver_Disease'], axis = 1)
```

In [14]:
```
y = liver_df['Liver_Disease']
```

In [15]:
```
X
```

Out[15]:

	Age	Gender	Total_Bilirubin	Direct_Bilirubin	Alkaline_Phosphotase	Alamine_Aminotransferase
0	65	0	0.7	0.1	187	16
1	62	1	10.9	5.5	699	64
2	62	1	7.3	4.1	490	60
3	58	1	1.0	0.4	182	14
4	72	1	3.9	2.0	195	27
...	...	...	...	...	...	..
478	60	1	0.5	0.1	500	20
479	40	1	0.6	0.1	98	35
480	52	1	0.8	0.2	245	48
481	31	1	1.3	0.5	184	29
482	38	1	1.0	0.3	216	21

480 rows × 10 columns

In [16]:
```
y
```

Out[16]:
```
0      1
1      1
2      1
3      1
4      1
      ..
478    0
479    1
480    1
481    1
482    0
Name: Liver_Disease, Length: 480, dtype: int64
```

In [17]:
```
from sklearn.model_selection import train_test_split
```

In [18]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_s
```

Oversampling

In [19]:
```
#https://beckernick.github.io/oversampling-modeling/
```

In [20]:
```
from imblearn.over_sampling import SMOTE
```

```
Using TensorFlow backend.
c:\program files\python37\lib\site-packages\tensorflow\python\framework\dtypes.
py:526: FutureWarning: Passing (type, 1) or '1type' as a synonym of type is dep
recated; in a future version of numpy, it will be understood as (type, (1,)) /
'(1,)type'.
  _np_qint8 = np.dtype([("qint8", np.int8, 1)])
c:\program files\python37\lib\site-packages\tensorflow\python\framework\dtypes.
py:527: FutureWarning: Passing (type, 1) or '1type' as a synonym of type is dep
recated; in a future version of numpy, it will be understood as (type, (1,)) /
'(1,)type'.
  _np_quint8 = np.dtype([("quint8", np.uint8, 1)])
c:\program files\python37\lib\site-packages\tensorflow\python\framework\dtypes.
py:528: FutureWarning: Passing (type, 1) or '1type' as a synonym of type is dep
recated; in a future version of numpy, it will be understood as (type, (1,)) /
'(1,)type'.
  _np_qint16 = np.dtype([("qint16", np.int16, 1)])
c:\program files\python37\lib\site-packages\tensorflow\python\framework\dtypes.
py:529: FutureWarning: Passing (type, 1) or '1type' as a synonym of type is dep
recated; in a future version of numpy, it will be understood as (type, (1,)) /
'(1,)type'.
  _np_quint16 = np.dtype([("quint16", np.uint16, 1)])
c:\program files\python37\lib\site-packages\tensorflow\python\framework\dtypes.
py:530: FutureWarning: Passing (type, 1) or '1type' as a synonym of type is dep
recated; in a future version of numpy, it will be understood as (type, (1,)) /
'(1,)type'.
  _np_qint32 = np.dtype([("qint32", np.int32, 1)])
c:\program files\python37\lib\site-packages\tensorflow\python\framework\dtypes.
py:535: FutureWarning: Passing (type, 1) or '1type' as a synonym of type is dep
recated; in a future version of numpy, it will be understood as (type, (1,)) /
'(1,)type'.
  np_resource = np.dtype([("resource", np.ubyte, 1)])
```

In [22]:
```
sm = SMOTE(random_state=42)
x_train_res, y_train_res = sm.fit_sample(X_train, y_train)
```

Using GridSearchCV to find the best parameters for Logistic Regression

In [23]:
```
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import GridSearchCV
from sklearn.ensemble import RandomForestClassifier
```

In [24]:

```
estimators = [20, 40, 60, 80, 100]
criterion = ['gini', 'entropy']
min_samples_split = [2,3,4]
max_features = ['auto', 'sqrt']




# Create hyperparameter options
hyperparameters = dict(n_estimators=estimators,criterion = criterion,min_samples_
```

In [25]:

```
rf = RandomForestClassifier(verbose=1, random_state=42)
```

In [26]:

```
clf = GridSearchCV(rf, hyperparameters, cv=5, verbose=0)
```

In [27]:

```
best_model = clf.fit(X_train, y_train)
```

```
[Parallel(n_jobs=1)]: Done  20 out of  20 | elapsed:    0.0s finished
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent worke
rs.
[Parallel(n_jobs=1)]: Done  20 out of  20 | elapsed:    0.0s finished
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent worke
rs.
[Parallel(n_jobs=1)]: Done  20 out of  20 | elapsed:    0.0s finished
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent worke
rs.
[Parallel(n_jobs=1)]: Done  40 out of  40 | elapsed:    0.0s finished
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent worke
rs.
[Parallel(n_jobs=1)]: Done  40 out of  40 | elapsed:    0.0s finished
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent worke
rs.

[Parallel(n_jobs=1)]: Done  40 out of  40 | elapsed:    0.0s finished
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent worke
rs.
[Parallel(n_jobs=1)]: Done  40 out of  40 | elapsed:    0.0s finished
```

In [28]:

```
print('Best n_estimators:', best_model.best_estimator_.get_params()['n_estimators
print('Best criterion:', best_model.best_estimator_.get_params()['criterion'])
print('Best max_features:', best_model.best_estimator_.get_params()['max_features
print('Best min_samples_split:', best_model.best_estimator_.get_params()['min_sam
```

```
Best n_estimators: 20
Best criterion: entropy
Best max_features: auto
Best min_samples_split: 3
```

Training with the best parameters

In [29]:
```
tuned_rf = RandomForestClassifier(n_estimators=20,
                                  criterion='entropy',
                                  max_features='auto'
                                  ,min_samples_split=3)
```

In [30]:
```
tuned_rf.fit(X_train,y_train)
```

Out[30]:
```
RandomForestClassifier(bootstrap=True, ccp_alpha=0.0, class_weight=None,
                       criterion='entropy', max_depth=None, max_features='aut
o',
                       max_leaf_nodes=None, max_samples=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=3,
                       min_weight_fraction_leaf=0.0, n_estimators=20,
                       n_jobs=None, oob_score=False, random_state=None,
                       verbose=0, warm_start=False)
```

In [31]:
```
y_preds = tuned_rf.predict(X_test)
```

In [32]:
```
from sklearn.metrics import classification_report
```

In [33]:
```
print(classification_report(y_test,y_preds))
```

```
              precision    recall  f1-score   support

           0       0.58      0.48      0.53        29
           1       0.79      0.85      0.82        67

    accuracy                           0.74        96
   macro avg       0.69      0.67      0.67        96
weighted avg       0.73      0.74      0.73        96
```

In [ ]: